Ch. 30 CQ: 10
P: 18, 20, 22

30.P.18 τ_{Al} ? $\sigma = \frac{n_e e^2 \tau}{m}$

$\sigma = \frac{n_e e^2 \tau}{m}$ $\quad m = 9.11\times10^{-31}\,kg$ $\quad n_e = 6.0\times10^{28}\,m^{-3}$

$\tau = \frac{m\sigma}{n_e e^2}$ $\quad \sigma = 3.5\times10^{7}\,\Omega^{-1}m^{-1}$ $\quad e = 1.602\times10^{-19}\,C$

$\tau = 2.07\times10^{-14}\,s$

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$\tau_{Fe} = 4.18\times10^{-15}\,s$

30.P.20 $1.5\times10^{-2}\,m$ Long Nichrome
$\Delta V = 1.5\,V$

a.) $\vec{E}$ = ? $\quad \vec{E} = \frac{\Delta V}{l} = 10\ V/m$

$\Delta V = 1.5\,V$
$l = 1.5\times10^{-2}\,m$

b.) J = ? $\quad J = \sigma E$

$\sigma = 6.7\times10^{5}\,\Omega^{-1}m^{-1}$ $\quad J = 6.7\times10^{6}\,A/m^2$

$E = 10\,V/m$

c.) $I = 2.0\,A$ $\quad J = \frac{I}{A}$ $\quad A = \pi r^2$

d = ? $\quad A = \frac{I}{J}$

$\pi r^2 = I/J$

$r^2 = I/J\pi$ $\quad 2r = D$

$I = 2.0\,A$ $\quad r = \sqrt{I/J\pi}$

$J = 6.7\times10^{6}\,A/m^2$ $\quad D = 2\sqrt{I/J\pi}$

$D = 6.16\times10^{-4}\,m$

$\vec{E} = 10\ V/m$
$J = 6.7\times10^{6}\,A/m^2$
$D = 6.16\times10^{-4}\,m$

30.P.22 $\vec{E} = 0.0075\ V/m$ Material?
$I = 3.9\times10^{-3}\,A$
$D = 1.0\times10^{-3}\,m$

Nichrome

$J = I/A$ $\quad J = \sigma E$

$I = 3.9\times10^{-3}\,A$ $\quad \sigma = J/E$

$A = \pi(0.5\times10^{-3}\,m)^2$ $\quad J = 4965.63\,A/m^2$

$J = (3.9\times10^{-3}\,A/(\pi(0.5\times10^{-3}\,m)^2))$ $\quad E = 7.5\times10^{-3}\,V/m$

$J = 4965.63\,A/m^2$ $\quad \sigma = (4965.63\,A/m^2 / 7.5\times10^{-3}\,V/m)$

$\sigma = 662085\,\Omega^{-1}m^{-1}$

$\sigma = 6.6\times10^{5}\,\Omega^{-1}m^{-1}$

Nichrome

30.C.10 I is doubled

a.) J? : $J = \frac{I}{A} \Rightarrow J = \frac{2I}{A}$: $2J = \frac{2I}{A}$

The current density will double

b.) The conduction is a property of the metal, it will not change

c.) This is also a property of the metal and will not change

d.) v_d? : $J = n_e e v_d \Rightarrow 2J = n_e e v_d$: $2J = n_e e 2v_d$

The drift speed will double